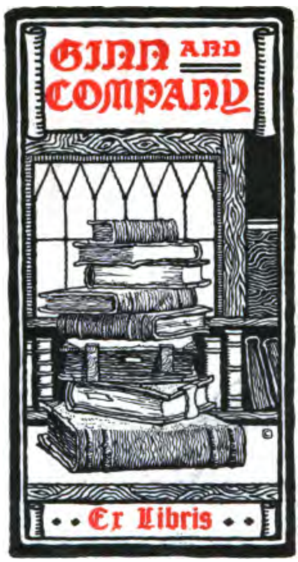
# Thurman's Rules for Reckoning Time, by Charles T. Thurman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# THURMAN'S RULES

FOR

# RECKONING TIME

WITH

## EXAMPLES AND ILLUSTRATIONS.

BY

C. T. THURMAN.

FOR USE IN SCHOOLS AND COLLEGES.

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# Preface.

In submitting these pages to the public the author wishes to impress the fact at the outset that he seeks to direct attention to but a single idea—Calculation of Time.

Himself a merchant engrossed with the cares of business, he has had neither the time nor the ability to produce anything at all elaborate—nor anything likely to interest one devoted to studies in Higher Mathematics, or engaged in occupations where perfectly accurate calculations of time are not necessary.

But we think a careful perusal of the work will convince all who read it, of what we believe to be a somewhat original idea—that hundreds of honest tombstones state unconscious falsehoods even as to the very ages they record, and that calculations of every sort involving time and date, and which we now concede to be only approximately correct, can be just as easily and simply made with the utmost exactness.

In seeking to illustrate our ideas, we have not manufactured "catches" or interesting puzzles, but have actually taken the examples here given from Arithmetics which are to-day Standard Text Books in the common schools of the country. We have selected the examples from the following well-known works:

| | |
|---|---|
| Ray's Practical Arithmetic | American Book Co. |
| Sutton & Kimbrough's Higher Arithmetic | D. C. Heath & Co. |
| Wentworth's Grammar School Arithmetic | Ginn & Co. |
| Milne's Standard Arithmetic | American Book Co. |
| White's New Complete Arithmetic | American Book Co. |
| High School Arithmetic, Wentworth and Hill | Ginn & Co. |
| Ficklin's National Arithmetic | American Book Co. |

The author is fully aware that it is dangerous to dispute such high authority as any of the foregoing authors;

but we simply point to the fact that the printed answers to the examples quoted from these books are really erroneous, as can be shown conclusively by *counting up the days*—though they are quoted merely to aid both writer and reader in their respective work, and certainly in no spirit of criticism or detraction.

The author believes that all of these accomplished mathematicians are possibly aware of the errors, and have probably considered the matter unworthy of notice, preferring to follow the methods and rules of established custom and business usage, to the risk of confusing those for whom these school-books are intended.

It is hardly credible that such palpable errors could escape the attention of such scholarly mathematicians as those from whose books we quote, and certainly when the fact is known to all the world that the ordinary rule for computing time is only approximately correct.

In a spirit of genuine modesty, then, we give these unpretentious pages to the public, conscious of grave faults both of style and presentation, sincerely trusting that they will be found of some substantial service to the busy toilers of our country, and of some use to others who are interested in the discovery of Truth, however sought.

We believe the principles laid down to be absolutely true, and the rules announced to be extremely simple and practical.

We are seeking neither notoriety nor wealth, but are prompted purely by a desire to serve our fellow men, however humble the service may be, and if by great good fortune we should give to the world a single new idea, we should be justly proud.

C. T. T.

McMinnville, Tenn., Feb. 15, 1897.

# The Thurman Rules

# For Reckoning Time.

The calendar is irregular, since the solar year contains the very complex period of 365 days, 5 hours, 48 minutes and 50 seconds. Our present calendar, with twelve months of irregular length, and leap-year occurring once in four years, has four months of 30 days each, seven months with 31 days each, and one month with 28 days for a common year and 29 days for a leap-year.

In reckoning time by this calendar, the universal rule has been to count by a *regular* rule which allows 12 months to the year and 30 days to the month. This only accounts for 360 days, a loss of 5 days for a common year and 6 days for a leap year.

Now, as only four months of the year contain exactly 30 days, it is quite obvious that many calculations based upon this *regular* rule must be at least *slightly* incorrect.

No such regular rule will correctly apply to an irregular calendar—as the months of different lengths are introduced at irregular intervals, and since we must also allow for the extra day in leap years. Hence, it is further apparent that a rule for reckoning time, in order to give perfect results, must adjust itself to the irregularities of the calendar, and to a certain extent depend upon them.

A careful study of the calendar will disclose the fact that one month, in all calculations of time, or expressions of date, seems to be responsible for all errors; it is our purpose to locate that month in any and all prob-

lems that may arise involving calculation of time and expression of date.

Nor must we ignore the fact that this is a matter of actual importance as well as of scientific interest, for, apart from the desire of all men to secure accurate results in all calculations where such results are simply and easily obtainable, and admitting the justice and feasibility of the ordinary Business Rule which allows only 360 days to the year, we cannot ignore the fact that if a man was born on a certain day of a certain year, and died on a certain day of a certain year, he was so many years, so many months and *so many days old*—and if, upon working the problem by an established rule, we find, by *actual count* of years, months and days, that an erroneous result has been obtained, we are forced to admit that some better rule is needed. It is our aim to formulate such a rule.

Partly to show the need of a better rule for calculating time, but chiefly to illustrate our own ideas, we give hereafter a number of examples selected from seven different Arithmetics—standard works now in actual use in American schools, books dating from Ray's Arithmetics, which appeared about 1857, to Milne's, Sutton and Kimbrough's, and Wentworth's, all of which have been issued since 1890. We have, in fact, been unable to find a single text-book in English embodying the principle we seek to establish—nor do we find a single Arithmetic from an English or American press, which has not the same erroneous rule for calculating time, and expressing date, as have the seven from which we quote.

In order to attract the reader's immediate attention, we shall at first confine ourselves to such problems as involve only date, ages and definite periods of time—

discussions and illustrations involving calculations of Interest, Partial Payments and Discount will be briefly treated of later.

We first invite attention to the following definitions and general formulæ, and to the Rules laid down—the application will readily appear from the examples which follow.

TIME is a completed period of duration, whether past or future. Example: 58 years, 2 months and 15 days.

DATE is the point of time at which a transaction, or event takes place. Example: July 4th, 1776, or 1776th year, 7th month and 4th day.

It must be further noted that in expressing all dates of the Calendar—arithmetically or otherwise—we are looking forward to the completion of a duration, and that as written, or expressed, each expression lacks the completion prospected.

Thus, "July 4th, 1776, (or "1776th year, 7th month, and 4th day,") means that since the birth of Christ have elapsed 1775 completed years, 6 completed months, and 3 completed days—and that we are now in the 4th day of the 7th month of the 1776th year since Christ was born.

Therefore, in reckoning time, we may regard expressions of date as an incomplete period of Time anticipating completion.

## FORMULÆ.

1. Date—Date=Time.
2. Date—Time=Date.
3. Date+Time=Date.
4. Time—Time=Time.
5. Time+Time=Time.

# CASE I.

## Formula 1.

Date—Date=Time.

## RULE.

From the numerically greater date, subtract the less, beginning with days.

If the number of days in the Minuend is greater than, or equal to, the number in the Subtrahend, subtract as in simple numbers.

If the number of days in the Subtrahend is greater than the number in the Minuend, add to the number of days in the Minuend the number of days actually belonging to the month previous to that month indicated in the Minuend; then subtract as in simple numbers, and "carry" to months in the usual way.

To subtract months, proceed as for days, observing that the number of months for the year previous to that indicated in the Minuend, is always twelve.

Subtract years as in simple numbers.

### EXPLANATION.

Wentworth's Grammar School Arithmetic, page 187, has the following example, actually worked out, explaining the ordinary rule: "Find the difference between April 3, 1885, and May 7, 1837.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1885 | 4 | 3 |
| 1837 | 5 | 7 |
| 47 | 10 | 26 Ans." |

Prof. Wentworth is fully aware that the foregoing is not a correct result, for he says in explanation: "In

finding the difference between long dates, 30 days are considered a month. In finding the difference between short dates, *the exact number of days is generally counted.*" Our foregoing rule applies to all dates, long or short, and while just as simple as the regular rule employed in above solution, obviates all necessity of "counting the exact number of days" in any case.

| | Yr. | Mo. | | Dy. | |
|---|---|---|---|---|---|
| | 1885 | 4 | (4+12) | 3 | (3+31) |
| | 1837 | 5 | | 7 | |
| By our rule: | —— | — | | — | |
| | 47 | 10 | | 27 | True result; |

For in the Minuend, April—the 4th month—is indicated; the *previous month*, March, was the last completed and is therefore the month actually borrowed (or reduced to days)—it contained 31 days—and so we add the 3 of the Minuend the 31 days borrowed, and subtracting 7, have a remainder of 27.

It is precisely as though we had written:

| Yr. | Mo. | Dy. | |
|---|---|---|---|
| 1885 | 3 | 34 | —Or March 34th, |
| 1837 | 5 | 7 | 1885. |
| —— | — | — | |
| 47 | 10 | 27 | |

But, in reality, upon reaching "months" we are compelled to again borrow—since we cannot subtract 5 from 3—and, as a matter of fact, we do borrow (reduced to months) the previous "year 1884;" and the above becomes as though we had written:

| Yr. | Mo. | Dy. | |
|---|---|---|---|
| 1884 | 15 | 34 | —Or the 34th day of 15th |
| 1837 | 5 | 7 | month of 1884th year. |
| —— | — | — | |
| 47 | 10 | 27 | |

The following examples taken from the various works noted, will fully illustrate the case under consideration, and the application of our rule. In each case we give side by side the solution by author quoted, and the correct solution.

Ex. 1.—"Milton was born Dec. 9th, 1608, and died Nov. 8th, 1675. What was his age at the time of his death?" (Milne's Standard Arithmetic, p. 197, Ex. 18.)

Milne's Solution.

| Yr. | Mo. | Dy. | |
|---|---|---|---|
| 1675 | 11 | 8 | (8+30) |
| 1608 | 12 | 9 | |
| 66 | 10 | 29 | |

Correct Solution.

| Yr. | Mo. | Dy. | |
|---|---|---|---|
| 1675 | 11 | 8 | (8+31) |
| 1608 | 12 | 9 | |
| 66 | 10 | 30 | |

NOTE:—The 11th month is indicated in minuend; month previous (Oct.) has 31 days.

Ex. 2.—A certain man was born June 24th, 1822. What was his age August 1st, 1848?" (Ray's Practical Arithmetic, p. 110, Ex. 28.)

Ray's Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1848 | 8 | 1 |
| 1822 | 6 | 24 |
| 26 | 1 | 7 |

Correct Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1848 | 8 | 1 |
| 1822 | 6 | 24 |
| 26 | 1 | 8 |

Ex. 3.—"At the birth of Lafayette, Sept. 6th, 1757, what was the age of George Washington, born Feb. 22nd, 1732?" (Wentworth's Gram. School Arith., p. 187, Ex. 2.)

Wentworth's Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1757 | 9 | 6 |
| 1732 | 2 | 22 |
| 25 | 6 | 14 |

Correct Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1757 | 9 | 6 |
| 1732 | 2 | 22 |
| 25 | 6 | 15 |

Ex. 4.—Find the difference in time between Sept. 17th, 1862, and March 4th, 1893." (Sutton and Kimbrough's Higher Arithmetic, p. 117, Ex. 18.)

Sutton and Kimbrough's Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1893 | 3 | 4 |
| 1862 | 9 | 17 |
| 30 | 5 | 17 |

Correct Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1893 | 3 | 4 |
| 1862 | 9 | 17 |
| 30 | 5 | 15 |

Here the month indicated in minuend is March; the *month previous* was February—and 1893 being a common year, had 28 days. Hence we borrow 28 days, instead of 30, regular rule, and the true result is really two *days less* than the ordinary rule would indicate.

Ex. 5.—"Find the time from May 10th, 1878, reckoning from midnight, to 3 o'clock p. m., Nov. 4th, 1891." (Ficklin's National Arithmetic, p. 190, Ex. 5.)

Ficklin's Solution.

| Yr. | Mo. | Dy. | Hr. |
|---|---|---|---|
| 1891 | 11 | 4 | 15 |
| 1878 | 5 | 10 | 0 |
| 13 | 5 | 24 | 15 |

Correct Solution.

| Yr. | Mo. | Dy. | Hr. |
|---|---|---|---|
| 1891 | 11 | 4 | 15 |
| 1878 | 5 | 10 | 0 |
| 13 | 5 | 25 | 15 |

That there may be no doubt whatever in the reader's mind as to the incorrectness of Ficklin's solution above, we offer the following

PROOF:

| Yr. | Mo. | Dy. | Hr. |
|---|---|---|---|
| 1878 | 5 | 10 | 0 |
| 13 | 5 | 24 | 15 |
| 1891 | 10 | 34 | 15 |

| Yr. | Mo. | Dy. | Hr. |
|---|---|---|---|
| 1878 | 5 | 10 | 0 |
| 13 | 5 | 25 | 15 |
| 1891 | 10 | 35 | 15 |

Now this is tantamount to stating that the date is Oct. 34th, 1891. But Oct. has only 31 days, hence two completed days, and the incomplete third day, must be placed in Nov., which makes the date arrived at Nov. 3, 1891. But we have asserted that the date was Nov. 4th, 1891!

This is tantamount to stating that the date is Oct. 35th, 1891. But Oct. has only 31 days, hence *three* completed days, and the incomplete *fourth* day, must be placed in Nov., which makes the date arrived at Nov. 4th, 1891, which we have asserted is the date in question.

Ex. 6.—"A man was born Sept. 12th, 1827, and his eldest son was born April 6th, 1855. What is the difference in their ages?" (White's New Complete Arithmetic, p. 136, Ex. 10.)

White's Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1855 | 4 | 6 |
| 1827 | 9 | 12 |
| 27 | 6 | 24 |

Correct Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1855 | 4 | 6 |
| 1827 | 9 | 12 |
| 27 | 6 | 25 |

Ex. 7.—"The American Civil War began April 11th, 1861, and closed April 9th, 1865. How long did it continue?" (Ficklin's National Arithmetic, p. 190, Ex. 7.)

Ficklin's Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1865 | 4 | 9 |
| 1861 | 4 | 11 |
| 3 | 11 | 28 |

Correct Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1865 | 4 | 9 |
| 1861 | 4 | 11 |
| 3 | 11 | 29 |

PROOF:

| | | |
|---|---|---|
| 1861 | 4 | 11 |
| 3 | 11 | 28 |
| 1864 | 15 | 39 |

| | | |
|---|---|---|
| 1861 | 4 | 11 |
| 3 | 11 | 29 |
| 1864 | 15 | 40 |

Or A. D. 1864th year, 15th month and 39th day, according to Ficklin's solution. That is, 1865th year, 3rd month and 39th day, or March 39th, 1865. But March has only 31 days, hence 7 completed days, and the incomplete 8th day (date) is to be placed in April, which makes the date arrived at April 8th, 1865, a patent fallacy. In the true solution, we have "March 40th, 1865." Giving 31 days to March, we have left 8 completed days in April, and the incomplete 9th day (date)—which fixes the date as stated in original minuend, viz: April 9th, 1865.

From a large number of such examples noted, the foregoing have been selected *almost at random;* the usual proof for such work will show the correctness of the rule we give in every instance. It is quite needless to multiply examples. It is to be carefully observed that we must always note the *month indicated in minuend*, and always borrow (when necessary) the *month previous* to the month so indicated. The reason for this is really very simple. A Date, in such operations, is to be treated as an Incomplete Period of Duration *looking forward to completion.*

Thus, "Feb. 14th, 1896" means that since the birth of Christ have elapsed 1895 completed years—and we are now in the incomplete 1896th; that we are in the incomplete 2nd month, with the 1st month of the 1896th year completed; that we are in the incomplete 14th day, with 13 days of the 2nd month completed. It is obvious, then, that when to any date we find it necessary to add a month, ("borrowing") the month so added must be the *month previous* to that month now being completed. The same is true when we must borrow from years for months—though it is of no practical consequence, since all years contain 12 months, while the months contain some 30, some 31, some 28 and even 29 days.

It sometimes happens, in fact, that we must borrow even the *two* previous months to effect proper subtraction for "days"—and hence must *carry two* to months. This is in strict accordance with the rule herein laid down and the principles stated.

Thus—

| Yr. | Mo. | Dy. | |
|---|---|---|---|
| 1894 | 3 | 1— | { 1+28+31=60. 60—31=29. Two months borrowed—hence carry 2 to months. |
| 1890 | 1 | 31 | |
| 4 | 0 | 29 | |

Here the month previous to the third—or March—was February; it contained 28 days; adding 28 to 1—or "borrowing the previous month," we would have

| Yr. | Mo. | Dy. |
|---|---|---|
| 1894 | 2 | 29—(28+1) |
| 1890 | 1 | 31 |

As we still cannot substract 31 from 29, for "days" we must again "borrow the previous month"—and the month previous to the second, or February, was January which has 31 days. Borrowing January, we have

| Yr. | Mo. | Dy. |
|---|---|---|
| 1894 | 1 | 60—(1+28+31) |
| 1890 | 1 | 31 |
| 4 | 0 | 29 |

As shown above, the same result would have been obtained if we had once "borrowed" the *two* previous months and "carried" *two*.

That this *is* the correct result, and that the "usual method" does *not* give a correct result, will be shown conclusively by the following

## PROOF.

Usual Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1894 | 3 | 1 |
| 1890 | 1 | 31 |
| 4 | 1 | 0 |

| Yr. | Mo. | Dy. |
|---|---|---|
| 1890 | 1 | 31 |
| 4 | 1 | 0 |
| 1894 | 2 | 31 |

Now, there is no 31st of Feb., for Feb. 1894, has only 28 days. Hence 28 completed days must be given to February, leaving to be placed in March 2 completed days and the incomplete 3d day (date)—which gives us the Minuend as March 3rd, 1894, or

| Yr. | Mo. | Dy. |
|---|---|---|
| 1894 | 3 | 3 |

—which we asserted in the premises to be

| Yr. | Mo. | Dy. |
|---|---|---|
| 1894 | 3 | 1 |

an error of *two entire days!*

Correct Solution

| Yr. | Mo. | Dy. |
|---|---|---|
| 1894 | 3 | 1 |
| 1890 | 1 | 31 |
| 4 | 0 | 29 |

| Yr. | Mo. | Dy. |
|---|---|---|
| 1890 | 1 | 31 |
| 4 | 0 | 29 |
| 1894 | 1 | 60 |

There is no 60th day of January, for January has only 31 days. So counting forward 31 days we have

| Yr. | Mo. | Dy. |
|---|---|---|
| 1894 | 2 | 29 |

But the second month, or February, 1894, had only 28 days—and hence, giving to February its 28 complete days, we have left the incomplete 1st day (date) to place in March, and the last reduction becomes

| Yr. | Mo. | Dy. |
|---|---|---|
| 1894 | 3 | 1 |

which is the original Minuend.

It remains only to discuss Leap Year to show the universal application of this rule and principle. Let us suppose:

"A tombstone records that a person died Sept. 18th, 1890, age 50 years, 6 months, and 20 days. On what day was that person born?"

| Usual Solution. | | | | Correct Solutiou. | | |
|---|---|---|---|---|---|---|
| Yr. | Mo. | Dy. | | Yr. | Mo. | Dy. |
| 1890 | 9 | 18 | | 1890 | 9 | 18 |
| 50 | 6 | 20 | | 50 | 6 | 20 |
| 1840 | 2 | 28 | | 1840 | 2 | 29 |
| 50 | 6 | 20 | PROOF. | 50 | 6 | 20 |
| 1890 | 8 | 48 | | 1890 | 8 | 49 |

There is no August 48th (8th month,) so giving August 31 days, we have left for September 16 completed days and the incomplete 17th day (date) which gives the original Minuend as Sept. 17th, 1890, whereas we asserted it was September 18th, 1890.

There is no August 49th, so giving August 31 days, we have left for September 17 completed days and the incomplete 18th day (date) —and this correctly gives the original Minuend as September 18th, 1890.

Another Leap Year application would be the following: "A child was born August 25th, 1860; died March 20th, 1876. How old?"

| Usual Solution. | | | | Correct Solution. | | |
|---|---|---|---|---|---|---|
| Yr. | Mo. | Dy. | | Yr. | Mo. | Dy. |
| 1876 | 3 | 20 | | 1876 | 3 | 20(20+29) |
| 1860 | 8 | 25 | | 1860 | 8 | 25 |
| 15 | 6 | 25 | PROOF. | 15 | 6 | 24 |
| 1860 | 8 | 25 | | 1860 | 8 | 25 |
| 1875 | 14 | 50 | | 1875 | 14 | 49 |
| 1876 | 2 | 50 | | 1876 | 2 | 49 |
| 1876 | 3 | 21 (50—29) | | 1876 | 3 | 20 (49–29) |

(1876 was a Leap Year—hence February had 29 days.)

It is useless to present more examples or hypotheses, involving this principle of subtracting dates.

We have purposely elaborated this case at the risk of wearying the reader, for the other cases to be presented will be more easily understood when this case is thoroughly mastered. Of course we have dealt with months of 31, 28 and 29 days—for if the "previous month" has 30 days, "usual rule" gives correct results, while of course the rule herein given, applies to any and all months, whether they have 31, 30, 28 or 29 days.

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## CASE II.

### Formula 2.

Date—Time=Date.

### RULE.

Subtract the days first, the months next and the years last.

If the number of days in the Minuend is greater than the number in the Subtrahend, subtract as in simple numbers. If the number of days in the Subtrahend is the same, or greater than the number in the minuend, add to the number of days in the Minuend the number of days actually belonging to the month previous to that month indicated in the minuend, then subtract as in simple numbers, and carry one to months in the usual way. To subtract months, proceed as for days, observing that the number of months in the year previous to that indicated in the Minuend is always twelve.

Subtract years as in simple numbers.

EXPLANATION.

Let us suppose the following problem:

"A man died Sept. 12th, 1895, aged 50 years, 10 months and 20 days. What was the date of his birth?"

The usual solution is as follows:

| Yr | Mo. | Dy. | |
|---|---|---|---|
| 1895 | 9 | 12 | (12+30) |
| 50 | 10 | 20 | |
| 1844 | 10 | 22 | |

A result which declares the man was born Oct. 22nd, 1844. Now when we seek to prove the result, we are confronted by the following:—

| | Yr. | Mo. | | Dy. |
|---|---|---|---|---|
| | 1844 | 10 | | 22 |
| | 50 | 10 | | 20 |
| | 1894 | 20 | (12+8) | 42 |
| Or— | 1895 | 8 | | 42=(31+11) |

Which declares that the man died on Aug. 42nd, 1895. So taking for August its 31 days, we have left for September (42—31=11) 10 completed days and the incomplete 11th day (date,) which finally declares the man died Sept. 11th, 1895, though the proposition states it to be Sept. 12th, 1895.

The usual rule therefore, does not give a correct result—as might have been anticipated from Case I.

The correct solution is as follows:—

| Yr. | Mo. | Dy. | |
|---|---|---|---|
| 1895 | 9 | 12 | (12+31) |
| 50 | 10 | 20 | |
| 1844 | 10 | 23 | Or Oct. 23d, 1844. |

PROOF.

| | Yr. | Mo. | | Dy. |
|---|---|---|---|---|
| | 1844 | 10 | | 23 |
| | 50 | 10 | | 20 |
| | 1894 | 20 | (12+8) | 43 |
| Or— | 1895 | 8 | | 43=(31+12) |

Or Aug. 43rd, 1895. But August has only 31 days—so to September belong 11 completed days, and the incomplete 12th day (date), which places date of man's death September 12th, 1895—a fact asserted in the hypothesis.

Of course by Case I, the same fact might have been simply shown.

| Yr. | Mo. | Dy | |
|---|---|---|---|
| 1895 | 9 | 12 | (12+31) |
| 1844 | 10 | 23 | |
| 50 | 10 | 20 | |

A few examples will suffice to cover this case, as in fact it follows as a natural and logical consequence from Case I. Almost any condition arising under Case I will find a corresponding solution under Case II, now under consideration.

Example 1.—"Lafayette was born Sept. 6th, 1757. He was 25 years, 6 months and 15 days younger than Washington. What was the date of Washington's birth?"

Usual Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1757 | 9 | 6 |
| 25 | 6 | 15 |
| 1732 | 2 | 21 |

Correct Solution.

| Yr. | Mo. | Dy. | |
|---|---|---|---|
| 1757 | 9 | 6 | (6+31) |
| 25 | 6 | 15 | |
| 1732 | 2 | 22 | |

The National Holiday is Feb. 22nd, not Feb. 21st!

Ex. 2—"A note was paid July 15th, 1894. It had been issued 1 year, 2 months and 15 days. When was the note drawn?"

Usual Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1894 | 7 | 15 |
| 1 | 2 | 15 |
| 1893 | 5 | 0 |

Correct Solution.

| Yr. | Mo. | Dy. | |
|---|---|---|---|
| 1894 | 7 | 15 | (15+30) |
| 1 | 2 | 15 | |
| 1893 | 4 | 30 | |

That is, the note was drawn May 0th, 1893—a new discovery (?) in the Calendar! This is a literal absurdity; no denomination of date can be expressed by a zero, or naught. It may be true that theoretically the 0th day of May may be the last day of April—but possibly it might be contended also that Dec. 25th is the "0th" day of May!

Here we have purposely taken a problem involving a 30 day month, because we wish to illustrate not the question of borrowing the "month previous," but a case involving a number of days in "Subtrahend the same as in Minuend"—where, as in the case of a *greater* Subtrahend, we "borrow the month previous," or "year previous," as required. It is easy to prove that the foregoing is a correct solution.

Ex. 3—"A man dies June 12th, 1896. His age is 50 years, 6 months and 10 days. What was the date of his birth?"

Usual Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1896 | 6 | 12 |
| 50 | 6 | 10 |
| 1846 | 0 | 2 |

That is: This man was born the 2nd of the 0th month 1846—a month unknown in our Calendar!

Correct Solution.

| Yr. | Mo. | | Dy. |
|---|---|---|---|
| 1896 | 6 | (6+12) | 12 |
| 50 | 6 | | 10 |
| 1845 | 12 | | 2 |

Which declares correctly that the man was born Dec. 2nd, 1845. The object of this example is to illustrate the application of the "Equal Subtrahend" for *months*, as in Ex. 2 for *days*. The proof of correct-

ness is easily shown by adding Remainder to Subtrahend in ordinary way.

Naturally, the question will be asked: Why do we thus borrow for "months" or "days" when the number in Subtrahend is the same as in Minuend? The explanation is that in such cases as Ex. 2 and Ex. 3, the numbers are equal only in a *digital* sense. Referring to our definition of Date, it will be observed that Date is a point in duration, and is considered, in arithmetical operations, an incompleted period of time, looking forward to completion. But Time is a completed Duration.

Therefore in the above Ex. 3, the expression "June 12th, 1896," or 1896th year, 6th month and 12th day, means that we are in the incompleted 1896th year since the beginning of the christian era; in the incompleted 6th month; and in the incompleted 12th day of that year. But 50 years, 6 months and 10 days are all completed periods of duration. It therefore follows that "the 6th month," representing as it does an incompleted duration is intrinsically less than "6 months," which represents a completed duration. In Ex. 2 we had the similar case of "the 15th day," an incompleted duration, and "15 days" a completed duration; and as before, the incompleted duration in the Minuend is intrinsically less than the completed duration in the Subtrahend.

Hence, the provision of the rule as to "Equal Subtrahends" is theoretically superfluous, for there is really no such condition under this formula, that could possibly arise with our ordinary Calendar. It is simply a case of "Greater Subtrahend," at least, where of course we borrow the "month previous," or "year previous," as already explained.

Ex. 4—"A farm was sold Aug. 20th, 1890, under a mortgage dated 5 years, 7 months and 20 days previous to sale. What was the date of mortgage?"

Usual Solution

| Yr. | Mo. | Dy. |
|---|---|---|
| 1890 | 8 | 20 |
| 5 | 7 | 20 |
| 1885 | 1 | 0 |

Correct Solution

| Yr. | Mo. | Dy. |
|---|---|---|
| 1890 | 8 (8+12) | 20 (20+31) |
| 5 | 7 | 20 |
| 1884 | 12 | 31 |

The incorrectness of the Usual Solution is obvious; the solution we give is correct, as can be easily proved by adding Remainder to Subtrahend. The example is given to direct attention to the fact that under the Ordinary Rule it is impossible to secure such a result as the "31st day," and only in a single case is it possible to fix a date in the 12th month—when under "months" Subtrahend is zero.

Ex. 5—"A tombstone records that a man died June 12th, 1896, at the age of 50 years, 3 months and 12 days. Find date of birth?"

Usual Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1896 | 6 | 12 |
| 50 | 3 | 12 |
| 1846 | 3 | 0 |

This declares (theoretically) that the man is born Feb. 28th, 1846—since there is no Mar. 0th.

Correct Solution

| Yr. | Mo. | Dy. |
|---|---|---|
| 1896 | 6 | 12 |
| 50 | 3 | 12 |
| 1846 | 2 | 31 |

This declares (theoretically) that the man was born Mar. 3rd, 1846—since there is no Feb. 31st.

INVESTIGATION.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1846 | 2 | 28 |
| 50 | 3 | 12 |
| 1896 | 6 | 10 |

| Yr. | Mo. | Dy. |
|---|---|---|
| 1846 | 3 | 3 |
| 50 | 3 | 12 |
| 1896 | 6 | 15 |

The one result declares the man died June 10th, 1896, the other June 15th, 1896—whereas the hypothesis is that he died June 12th, 1896. Clearly, then, there is a fallacy somewhere. If we investigate, we find, by adding age to date as below:—

| | Yr. | Mo. | Dy. | | Yr. | Mo. | Dy |
|---|---|---|---|---|---|---|---|
| If man is born | 1846<br>50 | 2<br>3 | 27<br>12 | he dies | 1896 | 6 | 8 |
| " " " | 1846<br>50 | 2<br>3 | 28<br>12 | " | 1896 | 6 | 9 |
| " " " | 1846<br>50 | 2<br>3 | 29<br>12 | " | 1896 | 6 | 10 |
| " " " | 1846<br>50 | 2<br>3 | 30<br>12 | " | 1896 | 6 | 11 |
| " " " | 1846<br>50 | 2<br>3 | 31<br>12 | " | 1896 | 6 | 12 |
| " " " | 1846<br>50 | 3<br>3 | 1<br>12 | " | 1896 | 6 | 13 |

It will be observed that if the man died, as stated, on June 12th, 1896—or

| Yr. | Mo. | Dy. |
|---|---|---|
| 1896 | 6 | 12 |

he *could* have been born only on Feb. 31st, 1846, if, as stated, he was 50 years, 3 months and 12 days old. But there *is* no Feb. 31st!

If this man had been born Feb. 28th, 1846, and had lived 50 years, 3 months and 12 days, he would have died June 9th, 1896, instead of June 12th, 1896; if he had been born March 1st, 1846—one day later—he would have died June 13th, 1896, instead of June 12th, 1896. Hence it appears that a difference of one day in date of birth, here makes a difference of four days in date of death. It is clearly impossible, in fact that *a man thus old could have died on June 12th, 1896*!

This problem is not given merely as an interesting fal-

lacy, or paradox, but the problem and its discussion, are designed to illustrate the discrepancies which are the natural result of an irregular Calendar. It is obvious, moreover, from a consideration of this problem that the "31 day month" is really the basis of all calculations for months—not only because 7 of the 12 months contain 31 days, but because it contains the *greatest number of days possible.* We have not sought to discuss this question exhaustively, however, and the topic is introduced chiefly for its suggestiveness.

In concluding the discussion of Case II, it is to be noted that while the reasons for "borrowing the previous month" have been suggested, their former discussion has been purposely deferred. In the discussion of Case III these reasons will be more clearly set forth. A further discussion of Case II is not to be desired in a work of such limited scope.

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## CASE III.

### Formula 3.

Date + Time = Date.

### RULE.

Add the years first, as they first accumulate—then the months. If the sum of months is more than twelve, reduce to years by subtracting the number of months in the year being completed in the reduction—(which is always twelve) Place under "months" the Remainder, which now indicates the month to which the days are to be added.

Then add the days. If the sum of days is more than the number of days in the month now indicated, reduce to months by subtracting therefrom the actual number of days

**in this indicated month, which is the month being completed in the reduction; place the Remainder under "days" and add one to months in the usual way. Should the months thus augmented exceed twelve, again reduce to years as before directed.**

**The years, months and days now indicated will denote the date sought.**

EXPLANATION.

The very notion of duration implies continuity. While for convenience, and perhaps from necessity, we measure time by years, months, days, etc., yet time itself is continuous.

If then we are counting backward from a certain point, or date, we proceed precisely in the reverse order to that order employed in reaching that point, or date. Thus, if we have reached the point Thursday in the week, we count in the order of Wednesday, Tuesday, Monday, etc.

It is to be expected, therefore, that, in counting back by months, if we have reached September, the order will be August, July, June, etc.

Now in subtracting Time from Date, as in the previous Case, we are simply counting back so many days, months and years from the point reached, which we term the "Date;" and to secure an accurate result it is absolutely necessary that when borrowing a month for a smaller Minuend—(or reducing a month to days to enable us to effect the arithmetical substraction)—that we should borrow that month immediately preceeding the month of the Date; and of course, if we reduce that preceeding month to days, the number of such days is fixed by the Calendar, and we must take 31, 30 or 28, according as the month is January, June or February, etc.

This is the reason for the rules heretofore given. When subtracting Date from Date in Case I, we are theoretically, counting back from the Date, or point of time, indicated in the Minuend, the number of years, months and days that have elapsed from the date indicated in the Subtrahend, to the date in Minuend, and, in actual practice, we may secure this result by treating the Subtrahend as though we were counting back from the point indicated in the Minuend that number of years, months and days which the Subtrahend *numerically expresses.*

The Regular Sequence, then, to be thus rigidly observed in counting back, we naturally expect in counting forward—and as a matter of fact, we *do* observe that Natural Order, or Sequence.

Case II and Case I, therefore, are really but corollaries of the general proposition as to Natural Sequence which we apply for Case III, and the only difference, in theory, between Case II and Case III is this order of Sequence. In Case II we are counting backward, in Case III we count forward.

Practically speaking, in Case II we are subtracting, and borrow the previous month (reduced to days) or the previous year (reduced to months) as occasion requires; while in Case III we are adding, and when the sum of months exceeds a year (always 12 months) we must add a year to the previous year, leaving the excess of months over 12 for a remainder to indicate the month being completed (in regular sequence)—and when the sum of days exceeds the number of days in that month thus designated, the month in question *is* completed—and necessarily the excess of days must be placed in the following month. This proposition is so simple it is hardly

worthy of serious elaboration—but to illustrate, let us suppose we are required to:

"Find the date of a child's death if the child was born May 6, 1885, age 5 years, 5 months and 29 days."

| Yr. | Mo. | Dy. | |
|---|---|---|---|
| 1885 | 5 | 6 | |
| 5 | 5 | 29 | |
| 1890 | — | | [May 6th, 1890.] |
| | 10 | — | [Oct. 6th, 1890, or 10th month.] |
| | | 35 | [October (6+29) 35th, 1890.] |

But October has only 31 days—hence, 3 completed days, and the incomplete 4th day (date) belongs in November (35—31=4.) The child therefore died Nov. 4th, 1890.

But, of course, as there is no month beyond the 12th—since the result is always a point in time, or date—we must take 12 of the months (when the month indicated in the sum numerically exceeds 12) and add to the year indicated in the sum. In theory, we do this because that year is a completed period of time in such a case, and the "excess of months" takes us into the following incomplete year. The following example will illustrate:

Ex. 1.—"Milton was born Dec. 9th, 1608, and died at the age of 66 years, 10 months and 30 days. What was the date of his death?"

| Yr. | Mo. | Dy. | |
|---|---|---|---|
| 1608 | 12 | 9 | |
| 66 | 10 | 30 | |
| 1674 | | | [Or Dec. 9, 1674.] |
| | 22=12+10 | | [Or 22d mo., 9th day, 1674—or since 22—12=10, (1674+1) th yr., 10th mo., 9th day—or Oct. 9th, 1675 ] |
| 1675 | 10 | | |
| | | 39 | [October 39th, 1675, or October (31+8)th) 1675, or Nov. 8th, 1675.] |

Practically, it is best to solve as follows:

Ex. 2.—"A note drawn Aug. 20th, 1894, was paid 2 years, 6 months and 15 days after date. What was the date of payment?"

| Yr. | Mo. | Dy. | |
|---|---|---|---|
| 1894 | 8 | 20 | |
| 2 | 6 | 15 | |
| 1896 | 14 (12+2) | 35 | |
| 1897 | 2 (Feb.) | 35 (28+7) | |
| 1897 | 3 | 7 | We here observe the 2d month indicated, Feb., which has 28 days. 35—28=7. Hence, we give the 2nd month its 28 days, and find ourselves at the 7th day in March. |

The note was therefore paid March 7, 1897.

Ex. 3.—"A man was born Sept. 30th, 1853. His age was 42 years, 4 months and 30 days. What was the date of his death?"

| Usual Solution. | | | Correct Solution. | | | |
|---|---|---|---|---|---|---|
| Yr. | Mo. | Dy. | Yr. | Mo. | Dy. | |
| 1853 | 9 | 30 | 1853 | 9 | 30 | |
| 42 | 4 | 30 | 42 | 4 | 30 | |
| 1896 | 3 | 0 | 1895 | 13 | 60 | |
| Or March 0th, 1896. | | | 1896 | 1 | 60 | (Jan. 60th, 1896) |
| | | | 1896 | 2 | 29 | (60—31=29.) |

As 1896 was a Leap year, the result is of course, correct; the true date is Feb. 29th, 1896.

The example is given to illustrate the neatness of the method here given and the rather clumsy method by which we are generally taught to solve the problem.

Ex. 4.—"Born, April 20th, 1800. Age 50 years, 4 months, 20 days. Find date of death."

| Usual Solution. | | | Correct Solution. | | | |
|---|---|---|---|---|---|---|
| Yr. | Mo. | Dy. | Yr. | Mo. | Dy. | |
| 1800 | 4 | 20 | 1800 | 4 | 20 | |
| 50 | 4 | 20 | 50 | 4 | 20 | |
| 1850 | 9 | 10 | 1850 | 8 | 40 | (Aug. 40th, 1850.) |
| | | | 1850 | 9 | 9 | (40—31=9.) |
| Or Sept. 10th, 1850. | | | Or Sept. 9th, 1850. | | | |

If in the above example, the completed month had contained 30 days, each solution would have given a true result, viz: 10th; if the completed month had contained 29 days, the usual solution would have given the 10th again, while the correct solution gives the 11th; if, finally the completed month had contained 28 days, the usual solution would still have given the 10th, while the correct solution would have given the 12th—an error of two days by usual method. This is clearly shown in the following problem.

Ex. 5.—"A marriage occurs June 18th, 1891. 3 years, 8 months, 22 days thereafter, a child was born. What was the date of its birth?"

| Usual Solution. | | | Correct Solution. | | | |
|---|---|---|---|---|---|---|
| Yr. | Mo. | Dy. | Yr. | Mo. | Dy. | |
| 1891 | 6 | 18 | 1891 | 6 | 18 | |
| 3 | 8 | 22 | 3 | 8 | 22 | |
| 1895 | 3 | 10 | 1894 | 14 | 40 | |
| | | | 1895 | 2 | 40 | (Feb. 40th, 1895.) |
| | | | 1895 | 3 | 12 | (40—28=12 ) |
| Or Mar. 10th, 1895. | | | Or Mar. 12th. 1895. | | | |

It is needless to multiply examples. As has been repeatedly suggested, every date is the result of an addition, and hence for the fixing of a date in any month, the month previous is directly responsible. Upon its length will depend the accurate fixing of the date in question—and the prime object of the foregoing rules has been to simply and clearly ascertain for any and all cases that month responsible for apparent irregularities.

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## CASE IV.

### Formula 4.

### Time—Time=Time.

### RULE.

**Subtract as other Denominate Numbers, beginning with days, and reckon the months always as 30 days, and years as 12 months.**

EXPLANATION.

In explanation of this peculiarity, it must be noted that we have here the simple subtraction of one Denom-

inate Number from another, and must of course, make use of a Regular Table. It is not a question of Calendar Irregularity, unless some *certain date is specified.*

If, for instance, we are asked to "Subtract from 50 years, 4 months and 12 days, 12 years, 7 months and 16 days," we find:—

| Yr. | Mo. | Dy. |
|---|---|---|
| 50 | 4 | 12 |
| 12 | 7 | 16 |
| 37 | 8 | 26 |

And the method of solution is identical with that in ordinary use.

But if we state the same proposition thus: "On July 4th, 1896, a father's age is 50 years, 4 months and 12 days, and his son's age is 12 years, 7 months and 16 days; required the exact difference of their ages"—we have added a feature which compels a reference to the Calendar. Nor can we secure a perfectly accurate result unless we first find the dates of their respective births, and then subtract these two dates. Thus:

**Father's Birth.**

| Yr. | Mo. | Dy. |
|---|---|---|
| 1896 | 7 | 4 |
| 50 | 4 | 12 |
| 1846 | 2 | 22 |

**Son's Birth.**

| Yr. | Mo. | Dy. |
|---|---|---|
| 1896 | 7 | 4 |
| 12 | 7 | 16 |
| 1883 | 11 | 18 |

Difference of Ages.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1883 | 11 | 18 |
| 1846 | 2 | 22 |
| 37 yrs. | 8 mos. | 27 dys. |

That this is the correct result is beyond question, and this method alone will give an accurate result for all possible cases. If, however, instead of choosing July

4th, 1896, as the original date of reckoning, we had taken June 4th, 1896, we would have secured a result, by the ordinary rule, accidentally correct.

So, many other dates might be taken, primarily involving 30 day months, from which would follow, by the ordinary method, results accidentally correct; but to secure an exactly correct result for any and all cases that may arise, the foregoing method of first reducing Time to Date, and then subtracting the dates, is necessary. When no date whatever is specified as a point from which to reckon, such reduction is of course, impossible.

The ordinary rule is for this case only approximately correct, and when any date of reckoning is given, or any "setting in the Calendar," it is liable to give erroneous results, as shown above.

It is hardly worth while to remark that if any date, or point of reckoning, is specified, Case IV becomes a form of Cases II and I.

## CASE V.

### Formula 5.

### Time+Time=Time.

### RULE.

**Add as other Denominate Numbers, beginning with days, reckoning months as 30 days and years as 12 months.**

EXPLANATION.

Thus:—"To 37 years, 8 months and 26 days, add 12 years, 7 months and 16 days."

| Yr. | Mo. | Dy. |
|---|---|---|
| 37 | 8 | 26 |
| 12 | 7 | 16 |
| — | — | — |
| 50 | 4 | 12 |

Here we could hardly manage to obtain any sort of "setting in the Calendar," or point from which to reckon, and really the problem is but the addition of two denominate numbers, where the use of a Regular Table is necessary. The ordinary table is only approximately correct, but for this particular case it is a matter of little consequence.

By reference to Case IV, it will at once appear that even could we manage to obtain some date from which to reckon, we would still be unable to secure greater accuracy; for we should be compelled finally to add Date to Date, which involves an absurdity.

In the discussions of all the foregoing cases, we have confined our illustrations, etc., to dates and ages, deeming it of prime importance to make all explanations as simple and practical as possible. It has appeared to us that if we could set forth the essential principles with sufficient clearness, some great obstacles in the way of teachers in our common schools might be removed, and possibly this is the gist of the whole matter at last. We have always presupposed that the reader understands the usual method of adding and subtracting denominate numbers, and the ordinary rules for subtracting dates and calculating time. We have intended that several matters should be merely suggestive, and we are fully aware that we have by no means exhausted the subject. The further practical applications are obvious, though we do not assume to say that they are of such great importance in business transactions as to necessitate immediate revision of methods. The following pages are designed to illustrate, in a simple manner, a few applications to ordinary business which have doubtless already occurred to the reader.

## INTEREST.

It is not our purpose seriously to propose for practical adoption, methods of calculation entirely at variance with the usage of business men, banks and courts—but if perfect accuracy is insisted upon, we are aware of no methods other than those here given by which it may be readily secured.

It is clearly possible that in the courts, questions might arise where the foregoing rules would directly apply; that in banks many calculations might be greatly facilitated by their use; that in all departments of business, the foregoing principles might serve just and useful ends.

Of course every principle herein set forth which applies to ages, etc., will apply to all questions involving Time and Date—and necessarily the inaccurate and unscientific method in general use for calculating time in problems of interest and discount, must often involve injustice and loss to one or other of the parties, and possibly no trifling sums, in the aggregate, are thus improperly diverted.

The application to Banking and Partial Payments is perhaps of more importance, and more direct, than in other forms of business transactions.

A few simple cases will suffice to illustrate—mostly selected from actual solutions in reputable text-books—and while the amounts involved may be small, and while we do not hope to convince the great business world of any serious error, or expect the immediate adoption of any material changes, we submit the question at issue for the consideration of all who are interested in such matters.

We believe our application will be found of great practical value to bankers. Of course all the text-books

considered in our illustrations, and all we have had the privilege of examining, have the same errors in calculating Interest, Discount, etc., hitherto noted—for if correct results are not secured as to Time, etc., it is impossible to secure a perfectly accurate result as to the rest of the work in question.

It would be entirely useless to note erroneous problems in text-books, since that has little to do with the matter before us, and almost a waste of time to multiply examples—for if we have shown that the ordinary method of reckoning time will not always give accurate results, it follows that the problems vitally involving such calculations cannot possibly be solved accurately by such a method. The following examples are intended chiefly to show the direct application of our formulæ, etc., to problems of Interest, Discount and Partial Payments, and the ease and simplicity of their employment.

Prof. Wentworth, who with great ability as a mathematician, unites both accuracy and neatness of methods, says—(Wentworth and Hill's H. S. Arithmetic, p. 234): "In business, a year is reckoned as 360 days in computing interest *for a time less than a year expressed in months and days*; hence, the interest is 5-365 or 1-73 too great. But general governments take the number of days between two given dates, and reckon for the interest such a part of a year's interest as this number of days is of 365 days."

If now, it is thus frankly conceded that all modes of calculating interest in common use are thus far incorrect, it must be at once apparent that some more accurate method of calculation is needed, and some more simple plan of counting the time by days, than those in ordinary use.

While we think the error of the usual method hardly so large as Prof. Wentworth states—since we do not really treat the year as 360 days so much as consider each month in turn as having 30 days, and thus find the chief source of error in the "previous month," as hitherto discussed—yet there can be no sort of question about the general principle of incorrectness stated.

A few examples, chosen almost at random, from the various text-books consulted will serve to illustrate more fully. The proposed illustration of time to Interest, etc., will be given later.

Ex. 1.—"If $2,150.00 is placed at interest May 10, 1877, what amount will be due Jan. 1, 1881, at 6 per cent?" (Ficklin's National Arithmetic, page 255, Example 17.)

FICKLIN'S SOLUTION.

| Yr. | Mo. | Dy. | | |
|---|---|---|---|---|
| 1881 | 1 | 1 | | 2150. |
| 1877 | 5 | 10 | | .06 |
| | | | 12 | 43.7 |
| 3 | 7 | 21 | | $2,619.78 Ans. |

BY CORRECT TIME.

| Yr. | Mo. | Dy. | | |
|---|---|---|---|---|
| 1881 | 1 | 1 | | 2150. |
| 1877 | 5 | 10 | | .06 |
| | | | 12 | 43.7⅓ |
| 3 | 7 | 22 | | $2,620.14 Ans. |

Ex. 2.—

"$644.40. TOPEKA, KANS., Mar. 13, 1890.

On or before Dec. 1, 1892, I promise to pay Joseph P. Edwards, or order, Six Hundred Forty-Four and 40-100 Dollars, with interest at 7 per cent per annum from date, for value received. J. K. HUNT."

Indorsements: Dec. 28, 1890, $300.00; April 18, 1892, $15.25; June 13, 1892, $260.50; find amount due Dec. 1st, 1892. (Sutton and Kimbrough's Higher Arithmetic, page 200, Example 8.)

Sutton & Kimbrough's Solution.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1892 | 12 | 1 |
| 1892 | 6 | 13 |
| 1892 | 4 | 18 |
| 1890 | 12 | 28 |
| 1890 | 3 | 13 |
| | 9 | 15=Interest $35.70. |
| 1 | 3 | 20=Interest $34.71. |
| | 1 | 25=Interest $4 25. |
| | 5 | 18=Interest $4.78. Ans. $147.84. |

BY CORRECT TIME.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1892 | 12 | 1 |
| 1892 | 6 | 13 |
| 1892 | 4 | 18 |
| 1890 | 12 | 28 |
| 1890 | 3 | 13 |
| | 9 | 15=Interest $35.70. |
| 1 | 3 | 21=Interest $34.86. |
| | 1 | 26=Interest $4.39. |
| | 5 | 18=Interest $4.79. Ans. $148.14. |

Ex. 3.—"A note for $10,000.00, dated Aug. 25, 1894, payable on demand, bears the following indorsements: Nov. 20, $500.00; Jan. 15, 1895, $500.00; Apr. 10, $500.00. What is due Aug. 1, 1895, reckoning interest at 10 per cent?"

| USUAL SOLUTION. | | | BY CORRECT TIME. | | |
|---|---|---|---|---|---|
| Yr. | Mo. | Dy. | Yr. | Mo. | Dy. |
| 1895 | 8 | 1 | 1895 | 8 | 1 |
| 1895 | 4 | 10 | 1895 | 4 | 10 |
| 1895 | 1 | 15 | 1895 | 1 | 15 |
| 1894 | 11 | 20 | 1894 | 11 | 20 |
| 1894 | 8 | 25 | 1894 | 8 | 25 |
| | 2 | 25 | | 2 | 26 |
| | 1 | 25 | | 1 | 26 |
| | 2 | 25 | | 2 | 26 |
| | 3 | 21 | | 3 | 22 |

Ans. Usual Solution, $9,387.22. Ans. $9,398.27.

A large number of examples from all the text-books examined, show errors similar to the foregoing, all arising from same cause. It is to be carefully noted that we do not give our own solutions as absolutely correct. For reasons hereafter given, we are quite sure that few correct solutions can be obtained in calculations involving time expressed by months. It is, in fact, all but impossible to compute interest with perfect accuracy and invariable certainty, by such a purely artificial rule as that of Davies, which reduces all expressions of time to months—years, months and days, alike. The foregoing examples, etc., are intended merely to show the defects of the present system of calculating interest, and the application of our formulæ—and in no sense as a criticism, or disparagement. All the text-books we have examined contain the same errors, attributable to the same causes, nor is anyone more fully aware of these facts than these authors themselves.

The time erroneous, the result inevitably erroneous, is a fact beyond dispute.

The remedy suggested will be found in the succeeding pages.

## BANKERS' RULE.

We believe that bankers, and all business men familiar with the use of Interest Tables, as well as those in the service of the general government, will find the following method of great value. It is the most natural and simple way of reckoning interest of which we have any knowledge—simple because almost as mechanical as multiplying by logarithms, and natural because in our calendar a month is a purely conventional and artificial division of time, while the year and the day are natural divisions with the fixing of which man has nothing whatever to do. Since all errors in applying Time to Interest arise from the artificial month, calculations should discard every form of reckoning by months, and the reckoning should be by years and days—in which case no error can possibly arise, as we are bound to follow in reverse order the natural sequence of days, months and years. Let us suppose the following: "Find the interest on a note for $756 at 7 per cent, dated Feb. 10th, 1893, and paid June 20th, 1896."

We first find the time as follows:

1896 June 20th.
Or 1896 May 51st=20+31.
Or 1896 April 81st=51+30.
Or 1896 Mar. 112th=81+31.
Or 1896 Feb. 141st=112+29.

| Yr. | Mo. | Dy. |
|---|---|---|
| 1896 | Feb. | 141 |
| 1893 | Feb. | 10 |
| 3 yrs. | | 131 dys |

$756×.07=$52.92.

Int. on $756 at 7 per ct. for 3 yrs.=$52.92×3=$158.76

Int. on $756 at 7 per ct. for 131 dys.= $\frac{\$52.92\times131}{366}$ =$18.94

Int. on Note=$177.70

It will be noticed in the foregoing solution we have written the *name* of the month instead of its *number*, and that in the final subtraction we have completely discarded all expression of months—as there really is none. The reduction and final subtraction might be just as easily effected by writing the number of the month instead of its name, in which case the result would stand:

| Yr. | Mo. | Dy. |
|---|---|---|
| 1896 | 2 | 141 |
| 1893 | 2 | 10 |
| 3 yrs. | 0 mo. | 131 dys. |

But it is a rather curious fact that while every one able to read seems to readily remember the number of days each month has, many remember with difficulty the number of the month. It makes no difference whether we write name or number of month, when expressing time only in years and days, as above.

The foregoing problem might have been solved as follows:

| | | |
|---|---|---|
| 1893 | February | 10th (Subtrahend.) |
| Or 1893 | January | 41st = 10+31 |
| Or 1892 | December | 72nd= 41+31 |
| Or 1892 | November | 102nd= 72+30 |
| Or 1892 | October | 133rd =102+31 |
| Or 1892 | September | 163rd =133+30 |
| Or 1892 | August | 194th =163+31 |
| Or 1892 | July | 225th =194+31 |
| Or 1892 | June | 255th =225+30 |
| 1896 | June | 20th (Minuend.) |
| Or 1895 | June | 386th (20+366, as year borrowed contained Feb. 29th.) |

| | Yr. | Mo. | Dy. |
|---|---|---|---|
| Therefore: | 1895 | June | 386 |
| | 1892 | June | 255 |
| | 3 | | 131—a result identical with that obtained in the first instance. |

Either process is equally effective to make the calendar months in Minuend and Subtrahend the same, i. e. both June, or both September, etc., and being identical in form it matters little which is employed, except for the sake of brevity.

From a consideration of the foregoing, we readily adduce the following

## RULE.

**Make the Calendar month of Minuend the Calendar month of Subtrahend, by borrowing in turn each previous month reduced to days, until the month of Subtrahend is reached. Then subtract as in simple numbers—the result will be expressed in years and days.**

**If more than six months must be borrowed to effect this reduction, it is best to reduce, in same manner, the Calendar month of Subtrahend to Calendar month of Minuend, then borrow in Minuend the number of days in the previous year, observing that this previous year ends at date of Minuend. Carrying one to years and subtracting, the remainder is expressed in years and days as before.**

NOTE.—*Previous Year.* In reducing month of Subtrahend to month of Minuend, it becomes necessary to borrow the previous year in Minuend, or year which has just been completed at date of Minuend. If that year contained Feb. 29th, we must borrow 366 days to secure a perfectly accurate result; if the year borrowed did *not* contain Feb. 29th, of course we borrow 365 days. It is, however, optional as to whether the month of Subtra-

hend shall be made the same as month of Minuend, or month of Minuend same as month of Subtrahend—a mere matter of convenience. *One*, or the other, must be thus reduced—*not both*—and each process secures precisely the same result.

Ex. 1.—"Find interest on note for $1758.63 at 5 per cent from Feb. 10th, 1894, to Dec. 20th, 1894."

**Usual Method.**

Feb. 18 (28—10)
Mar. 31
Apr. 30
May 31
June 30
July 31
Aug. 31
Sept. 30
Oct. 31
Nov. 30
Dec. 20
———
313 dys.

**Method of Rule.**

| | Yr. | Mo. | Dy. | |
|---|---|---|---|---|
| | 1894 | Dec. | 20 | (20+365=385) |
| | 1894 | Feb. | 10 | |
| Or | 1894 | Jan. | 41 | |
| Or | 1893 | Dec. | 72 | |
| | | | 313 | (385—72) |

Either case: $\dfrac{1758.63 \times .05 \times 313}{365}$ = Answer.

It is to be noted that we here reduced the Subtrahend, by writing it Dec. 72nd, 1893, then borrowed a year in Minuend, writing it Dec. 385th, 1893, and of course 385—72=313.

Ex. 2.—"Find time in years and days between Aug. 12th, 1893, and Oct. 22d, 1895."

Practical solution:

| | | |
|---|---|---|
| | 8 | 83 |
| | 9 | 52 |
| 1895 | 10 | 22 |
| 1893 | 8 | 12 |
| 2 | 0 | 71 |

Ex. 3.—"Find time expressed in days and years between May 20th, 1885, and July 19th, 1885."

| | | | |
|---|---|---|---|
| | | 5 | 80 |
| | | 6 | 49 |
| Practical Solution: | 1885 | 7 | 19 |
| | 1885 | 5 | 20 |
| | | | 60 |

Ex. 4.—"Find days between Nov. 28th, 1896, and Jan. 20th, 1897."

| | | | |
|---|---|---|---|
| | 1896 | 11 | 81 |
| Practical Solution: | 1896 | 12 | 51 |
| (Min.) | 1897 | 1 | 20 |
| (Sub.) | 1896 | 11 | 28 |
| | | | 53 |

Ex. 5.—"Find days between June 19th, 1893, and May 27th, 1894."

| | | | | |
|---|---|---|---|---|
| Practical Solution: | 1894 | 5 | 27 | (27+365=392) |
| | 1893 | 6 | 19 | |
| | | 5 | 50 | |
| | | | 342 | |

The foregoing examples will suffice to show the application of the method of finding time between two dates in years and days, in all problems of Interest, True Discount, Bank Discount, Partial Payments, etc. No particular interest rule is necessary for the application—as the only change proposed is to discard the month as a measure of time, since errors seem to arise solely from its employment, and since there is no appreciable error possible in calculations involving only years and days.

The adding of Days of Grace, etc., is of course as simple as in the ordinary methods of working interest.

Briefly, the most natural way of calculating interest by this method would seem to be:

1. Multiply principal by rate, to get interest for one year.

2. Multiply interest for one year by number of years.

3. Multiply interest for one year by number of days, and divide by 365.

4. Add together interest for total years and total days, which is total interest.

5. To be mathematically *exact*, if the year previous to, and ending at, the last day of reckoning, contained Feb. 29th, divide by 366, and if it did *not* contain Feb. 29th, divide by 365. Thus on page 43 we have divided by 366 because the 131 days was part of leap year ending at payment of note.

As before remarked, the method is especially valuable to those who make use of Interest Tables though applicable to the calculation of interest in any form.

As remarked at the beginning, the Irregular Calendar Month is responsible for most errors of Time and Date, and the month chiefly thus responsible is that previous to the month in which is found the Date, or point of reckoning.

It has been further remarked that the month is a conventional, or artificial division of time, while the day and year are natural divisions: and hence it is to be expected that rules and principles involving only such natural divisions will give accurate results, while methods depending on artificial divisions will prove a fruitful source of error.

It has been our aim to formulate a system at once simple, accurate and philosophical.

If in this we have been remotely successful we shall feel that in spite of their seeming insignificance our efforts have not been in vain.